EXPLOSIVE FLASHLIGHT

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Fig. 1.

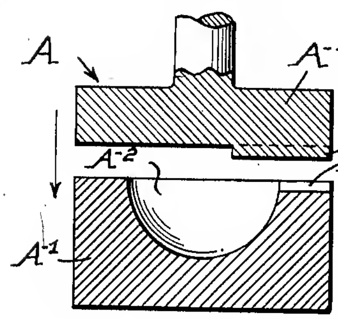


Fig. 3.

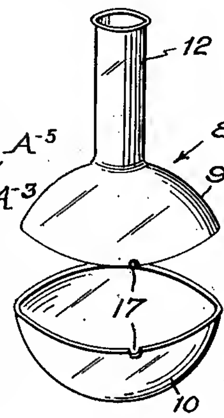


Fig. 4.

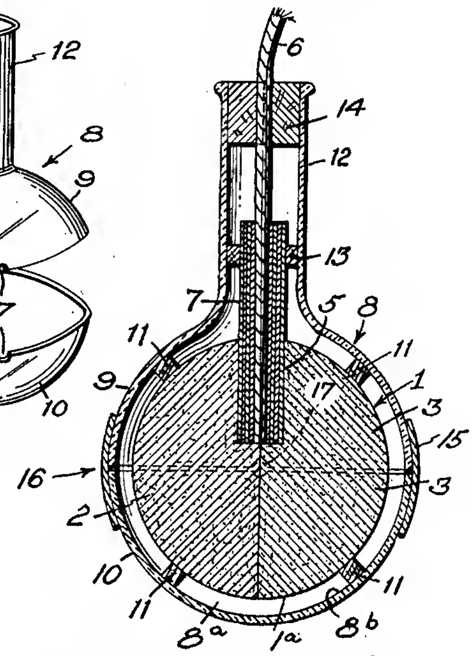


Fig. 2.

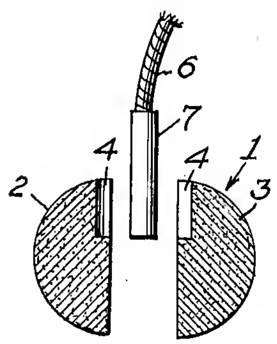
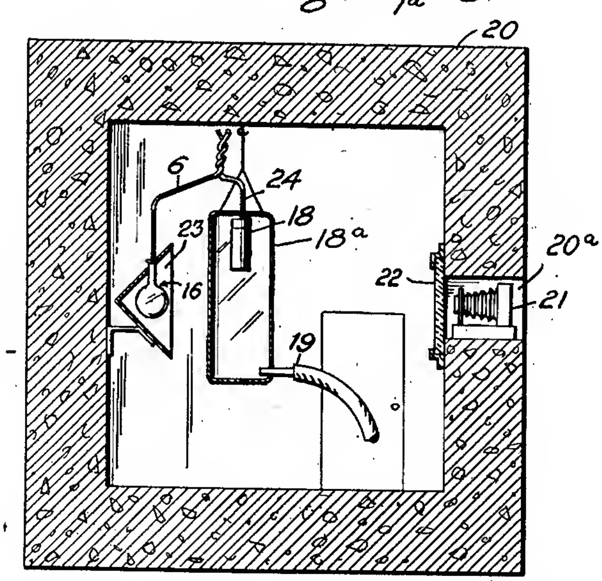


Fig. 5.



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EXPLOSIVE FLASHLIGHT

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11 Claims. (Cl. 346—107)

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This invention relates to a new and useful improvement in methods of photographing detonation phenomena.

The essential feature of our improved method of photographing detonation phenomena is the production of a light of determined luminosity and period of duration by the detonation of a charge of explosive, which detonation is produced in determined time relation to the detonation of the charge of explosive the phenomenon of which is to be photographed. The essential features of our improved method of producing the flash bulb, for use in practicing our improved photographing method, are the production of the explosive charge and a translucent envelope therefor, so relating them as to provide an area between the charge and envelope, and charging this area with a gas having positive luminous shock wave properties, the luminosity and period of duration of the light produced by the explosive charge being precisely determined by the character of the charge, envelope and gas and their mutual relationship. The essential feature of our improved flash bulb, produced by our improved method, is the combination of the charge, envelope and gas comprising the bulb.

It has been known that the degree of luminosity of light produced by detonation of a charge of explosive is markedly influenced by the atmosphere surrounding the charge. The light is produced in the shock wave ahead of the expanding products of detonation. The gas in this shock wave front undergoes an adiabatic compression and the temperature attained depends on the value of the heat capacity ratio for the atmosphere in which the shock wave travels. For a given temperature, the light-emitting power of the gas is, in general, greater for the gases of higher density. Thus, for maximum light intensity, the higher density monatomic gases are most effective.

As far as we know, the high intensity flash, produced by detonating a charge of explosive, had not been used as the light source for flashlight photography of detonation phenomena, prior to our invention of our improved method using such flash. The successful practice of our improved method of photographing detonation phenomena, by the use of the light produced by detonating an explosive charge, has demonstrated the superiority of our method over those in which spark lighting is used, since in our method the degree of luminosity and the period of duration of the flash, and the timing of the detonation producing the flash are all subject to easy, precise and effective control to a degree not possible in prior known methods. We have successfully produced photographs of detonation phenomena, by our improved method, using our improved flash bulb produced by our improved method of production, which produced a light having a photographic intensity of 10^8 candlepower and a period of duration of 10^{-6} seconds. In producing the said photographs use was made of the method and apparatus for covering a camera lens disclosed and claimed in co-pending application Serial Number 646,454, filed February 8, 1946, now Patent 2,470,139, dated May 17, 1949.

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We have illustrated in the drawing filed herewith and have hereinafter fully described one specific embodiment of our invention as to our improved flash bulb produced by our improved process, and also certain instrumentalities for use with our improved bulb for practicing our improved photographing method. It is to be distinctly understood that we do not consider our invention to be limited by the disclosure of said specific embodiment but refer for its scope to the claims appended hereto.

In the drawings:

Figure 1 is a section of a mold suitable for producing the complementary halves of a spherical charge of explosive for the flash bulb.

Figure 2 is a section showing the charge halves and a foil-wrapped detonator fuze prior to assembly.

Figure 3 is a perspective of a transparent flask in two sections, to serve as the envelope for the charge and fuze illustrated in Fig. 2.

Figure 4 is a vertical section of the completed flash bulb.

Figure 5 is a vertical section of a light-proof and bomb-proof chamber illustrating the positioning of the flash bulb and the other instrumentalities for the practice of our improved photographing method.

As illustrated in the drawings, the spherical charge of an explosive, such as "pentolite," may be produced by utilizing a mold as illustrated in Figure 1. The mold A has a matrix A–1 provided with a hemispherical concavity A–2 and a semicylindrical groove A–3 radiating from the periphery of concavity A–2, and a cope A–4 having a semi-cylindrical core A–5 corresponding to groove A–3 and extending radially into concavity A–2. The mold A produces a spherical charge 1 comprising the hemispherical halves 2 and 3, each having the semi-cylindrical groove 4 which, when the halves 2 and 3 are united, form the cylindrical bore 5. As shown in Figs. 2 and 4, a

fuze 6, made of prima cord, has its end wrapped with several relatively thin layers of lead foil 7 which is then received in the bore 5 when the halves 2 and 3 are united. It is to be particularly noted that this peculiar relation of the fuze 6 to the charge 1 insures detonation of charge 1 at its center. A translucent spherical envelope 8, such as a glass flask, divided into hemispherical portions 9 and 10, is provided for the charge 1 which is disposed concentrically in the envelope 8 by means of spacers 11 of any suitable material, such as cork. The fuze 6 with its end wrapped in foil 7 is held in place in neck 12 of envelope 8 by suitable split plugs 13, 14.

After the charge 1 with its fuze 6 has been disposed in proper relation to portion 9 and neck 12, the portions 9 and 10 are connected by any suitable translucent bonding medium 15, such as collodion or "Scotch tape," to completely assemble the flash bulb 16. It will be noted that the spacers 11 provide a space 8–A in the envelope 8 between the outer surface 1–A of the charge 1 and the inner surface 8–b of the envelope 8, and by reason of the fact that the spherical charge 1 and the spherical envelope 8 are concentrically relatively disposed, the spacers 11 being of uniform thickness, this space 8–A has uniform dimension radially of the spherical charge. This space 8–a is filled, through opening 17 in the envelope 8, with a gas having positive luminous shock wave properties, such as argon which proved very satisfactory in the actual practice of our improved method. The method for charging the envelope 8 with the argon was as follows. The bulb 16 was placed in a desiccator (not shown) from which air was evacuated and replaced by argon which passed through opening 17 to fill space 8–A, the opening 17 then being closed. The bulb 16 was placed in desiccator until immediately before use, thereby minimizing loss of argon from envelope 8.

Since the blast from detonation of charge 18 of the explosive the phenomenon of which is to be photographed is intensely self-luminous in air, it is necessary that charge 18 be detonated in an atmosphere having negative luminous shock wave properties. Charge 18 is housed in a suitable translucent sealed envelope 18–a such as a bag of cellulose acetate which proved very satisfactory in the practice of our improved method, and suitable gas, such as ether vapor or propane-butane gas, is supplied to envelope 18–a through hose 19 introduced into envelope 18–a to produce an atmosphere having the desired negative luminous shock wave properties.

The bulb 16 containing charge 1, and the envelope 18–a containing charge 18 are suitably disposed in a light-proof and bomb-proof chamber 20. A photographing means 21, such as a camera, is suitably positioned in chamber 20–a in the wall of chamber 20, relative to bulb 16 and envelope 18–a. Means 21 is operative through and protected by a transparent bullet-proof window 22. The bulb 16 is provided with a suitably disposed reflector 23.

The timing of the firing of charges 1 and 18 is determined by varying the relative lengths of the prima cord fuzes 6 and 24 connected to the charges 1 and 18 respectively.

Having described our invention, what we claim is:

1. That method of determining detonation phenomena of an explosive comprising detonating a test specimen of said explosive, substantially simultaneously detonating a second charge of

explosive while enveloped in a gas having positive luminous shock wave properties, and photographing the detonation of said test specimen by the light afforded by the detonation of said second charge of explosive.

2. That method of photographically determining the detonation characteristics of a first explosive, comprising, simultaneously detonating a second explosive in an atmosphere having positive luminous shock wave properties, and photographing the detonation of said first explosive by the illumination afforded by the detonation of said second explosive.

3. That method of photographing detonation phenomena of a first explosive charge, comprising, detonating in predetermined timed relation with detonation of said first explosive charge a second explosive charge surrounded by a gaseous monatomic element having positive luminous shock wave properties and positioned adjacent said first charge, and photographing the detonation of said first charge by the illumination afforded by said second charge.

4. That method of determining detonation phenomena of a first explosive charge, comprising, detonating substantially simultaneously with detonation of said first explosive charge, a second explosive charge surrounded by a gaseous medium having positive luminous shock wave properties and positioned adjacent said first explosive charge, and photographing the detonation of said first explosive charge by the illumination provided by said second explosive charge.

5. The method of photographing the detonation of a first charge of explosive to be tested, comprising, detonating said first charge while enveloped in an atmosphere having negative luminous shock wave properties, substantially simultaneously detonating a second charge of explosive surrounded by an atmosphere having positive luminous shock wave properties, and photographing the detonation of said first charge by the illumination afforded by the detonation of said second charge.

6. That method of testing the detonation characteristics of an explosive, comprising, detonating a charge of said explosive in an atmosphere having negative luminous shock wave properties, and photographing said detonation by the illumination afforded by the substantially simultaneous detonation of a second charge of explosive in an atmosphere having positive luminous shock wave properties.

7. In an apparatus for testing detonation characteristics of an explosive, means for supporting a charge of said explosive within an atmosphere of gas having negative luminous shock wave properties, a second charge of illuminating explosive, means supporting said second charge adjacent said first charge within an atmosphere of gas having positive luminous shock wave properties, and means to detonate said charges in predetermined timed relation.

8. In an apparatus for photographing the detonation characteristics of an explosive, camera means, means supporting a charge of said explosive in position to be photographed by said camera means, illuminating means comprising a second charge of explosive, a flask of light-transmitting material, means mounting said second charge within said flask in spaced relation with the inner walls thereof to provide a space-envelope thereabout adapted to be filled with a gas having positive luminous shock wave properties, means mounting said flask adjacent said explo-

sive charge to be tested, and means operable to detonate said charges substantially simultaneously.

9. In an apparatus for photographing the detonation characteristics of explosives, a camera, a first translucent container, a specimen charge to be detonated, means suspending said charge within said container in position so that the detonation thereof may be photographed by said camera, an illuminating charge of explosive, a second translucent container, means supporting said illuminating charge within said second container in spaced relation with the walls thereof, means supporting said flask in position adjacent said container, and means to detonate said two charges substantially simultaneously.

10. An apparatus as recited in claim 9, and a gas having positive luminous shock wave properties confined in said second container.

11. An apparatus as recited in claim 10, and

a gas having negative luminous shock wave properties confined in said first container.

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